year, in which spring girdling is preferable. This renders the timing of girdling a dilemma which faces the grower every year.

In order to overcome this dilemma, the effects of girdling in an intermediate season – winter – were investigated. December was chosen as the month for winter girdling, following preliminary experiments which showed December girdling to be more useful than January girdling, and since during January differentiation into flower buds comes to an end.

A comparison among the effects of autumn girdling (mid-October and mid-November), winter girdling (mid- and end-of-December) and spring girdling (during flowering, in March and April) was made between trees that had only about two-thirds of their branches girdled.

The results of these comparisons showed November to be preferable to October girdling, as it causes less damage to the trees. There was no difference between mid- and end-of-December girdling, both of which had a somewhat stronger effect on raising the number of fruits than did girdling in the two other seasons.

Actually, winter girdles were as effective as, or even more so than, the most suitable season, be it spring or autumn. Winter girdlings do, however, have an adverse effect on fruit size, and although this effect is less than that encountered due to autumn girdling, it still cannot be overlooked. The results of the various experiments presented in this study indicate that winter girdling does, to some extent, act both as autumn and spring girdling, and this seems to be the reason for its effectiveness in raising yields.

*Key Words:* Girdling, fruit number, fruit size, flower bud differentiation, fruit set.

## ON BIOLOGICAL CONTROL OF THE MEDITERRANEAN BLACK SCALE, *SAISSETIA OLEAE* (OLIVIER), IN ISRAEL

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In the early 1970's, the population levels of the Mediterranean black scale (*Saissetia oleae* [Olivier]) increased considerably in citrus and olive groves in the coastal plain of Israel. During 1970-1975, bivoltine populations of *S. oleae* were recorded for the first time in several citrus groves. Potato sprouts detached from soil were most suitable for mass rearing *S. oleae*, the hemispherical scale (*Saissetia coffeae* [Walker]), and their parasites.

During 1972-1978 nine species of African hymenopterous parasites were introduced into Israel by the Department of Entomology, A.R.O. The pteromalid *Scutellista* aff. *cyanea* Motschulsky and the encyrtids *Metaphycus lounsburyi*

(Howard) and *M. bartletti* Annecke and Mynhardt became established very rapidly in the field. Establishment of *Metaphycus swirskii* Annecke and Mynhardt was slow and occurred in populations of the pyriform scale (*Protopulvinaria pyriformis* [Cockerell]) but not in *S. oleae*. In recent years *M. bartletti* has been the most abundant parasite of *S. oleae* on citrus.

The brown soft scale (*Coccus hesperidum* L.) and *S. coffeae* were not suitable for the development of *M. swirskii*, due to encapsulation of most of the parasite eggs by the two coccids. Comparative laboratory studies have shown that *M. bartletti*, as opposed to *M. swirskii*, possesses biological characteristics which favor its year round survival and rapid establishment in the citrus grove. *M. bartletti* appears to be the main biocontrol agent in curbing the *S. oleae* populations in Israel.

*Key Words:* Citrus, olives, *Saissetia oleae*, biological control, parasites, *Metaphycus* spp.

## EFFECT OF VOLATILES ON THE DEVELOPMENT OF CHILLING INJURY IN LONG-TERM STORAGE OF CITRUS FRUITS AT SUBOPTIMAL TEMPERATURE

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Clear differences were found to exist among citrus fruit cultivars in their sensitivity to chilling injury: grapefruit and 'Shamouti' oranges exhibited the greatest sensitivity to chilling, lemon an intermediate sensitivity, and 'Valencia' oranges the lowest. Different treatments prior to or during cold storage were applied for the reduction or prevention of chilling injury in citrus fruit: conditioning to low temperature, or to higher $CO_2$ concentration before storage at the low temperature; coating the fruit with wax or wrapping it in polyethylene film; dipping the fruit in thiabendazole or vegetable oils; and employing intermittent warming (I.W.) during cold storage. No action has been taken to put these treatments to practical use in order to enable long-term storage at suboptimal temperature without causing chilling injury. During the 1970's we studied the storage capability of lemon at different temperatures and used I.W. to prevent chilling injury and determined that a cycle of 7 days at 13°C after 21 days at 2°C was the best for long-term storage of lemon for 5 months and longer in good marketable quality. I.W. during cold storage reduced pitting and subsequent mold rot development and membranosis, maintaining the juice, total soluble solids, acidity, weight loss and respiration at a better level than in fruit stored continuously at 2°C. The present research was instituted to clarify what